
USER'S GUIDE

AUTO DIAL

212A

MODEM



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GENERAL INFORMATION

The Auto Dial 212A is used to connect your computer or computer terminal to the telephone network. The term **modem** is derived from "modulator-demodulator." Data entered at your terminal is modulated by the modem into a form that can be sent down the phone lines. The modem at the other end of the call demodulates the signal into a form that can be used by the computer. In a like manner, the computer can transmit back to your terminal. The Auto Dial 212A can handle the transmission and reception of data simultaneously. This mode of data transmission is known as "full duplex."

The Auto Dial 212A connects directly to the public telephone network via a standard RJ11C phone jack and transmits and receives data at the rate of 1200 baud (120 characters per second) or in low speed mode, at 300 baud. It is Bell 212A/103 compatible.

In a computer link-up over the phone network, the side placing the call is referred to as the "ORIGINATE" side. The side answering the call is referred to as the "ANSWER" side. The Auto Dial 212A will operate in originate, answer, auto answer and auto dial modes.

Front Indicators

CD	Carrier Detect	On when the Auto Dial 212A receives a carrier tone from a remote modem, indicating that data transmission is possible.
HS	High Speed	On during a high speed call. Undefined between calls.
OH	Off Hook	On when the Auto Dial 212A takes control of the phone line to establish a data link.
TR	Terminal Ready	On when the modem receives a Data Terminal Ready signal from the terminal or computer it is connected to (RS232C pin 20), or when DTR override (Dip Switch Segment 4) is turned on.
RD	Receive Data	Flashes when a data bit is received by the Auto Dial 212A from the phone line, or when the modem is sending result codes to the terminal device.
AN	Answer Mode	On when the modem is in answer/command mode.
SD	Send Data	Flashes when a data bit is sent by the terminal device to the Auto Dial 212A.
AL	Analog Loopback	On when the Auto Dial 212A is in Analog Loopback/Self-Test mode.
ON	Power On	On when the Auto Dial 212A is powered on.

Front Switches

AL Analog Loopback (self-test)

IN = On

OUT = Off

ON Power On

IN = On

OUT = Off

Rear Dip Switches

RNG = RING

OFF = Auto Answer (for dial-up phone installations)

ON = Continuous Answer (for dedicated lines)

8 HI = Pin 8 High

OFF = RS232 pin 8 clamped high.

ON = Pin 8 goes high and low with carrier detect.

BAL = Balance (Line Equalization)

OFF = Standard phone line.

ON = Very short Line.

DTR = Data Terminal Ready

OFF = Computer pin 20 controls modem.

ON = DTR override, modem ignores pin 20.

Installation Steps

- Connect the wall mount transformer to the modem and a 115 volt AC outlet.
- Connect the RS232C cable from your terminal or computer to the modem.
- Set your terminal to 300 or 1200 baud.
- Set your terminal to full or half duplex.
- Unplug telephone cable from wall and plug into either RJ11C modem jack.
- Plug phone cable provided into the phone line wall jack and into the remaining modem jack. The telephone is not an essential part of the installation and may be omitted. (Older telephone installations may not have the appropriate wall jack and plug. Adapters and RJ11C connectors are available from your telephone company or computer dealer.)
- Select correct rear dip switch settings on modem. Note, the modem is factory shipped with the most commonly required settings.

- Place AL front panel switch in the OUT (normal operation) setting.
- Power On.
- To verify that the modem is ready to accept commands, type "AT" and strike the carriage return (cr). The modem should respond "OK".

AUTO DIAL OPERATION

The Auto Dial 212A is instructed to dial a phone number by ASCII commands given to it by the terminal or computer via the RS232 interface. In the following description, characters shown in quotes ("") are commands that would be given to the Auto Dial 212A to perform dialing.

All commands must be initiated by the two character code "AT" (for ATTENTION). The commands must be entered in upper case. They are executed only when you strike the carriage return (cr), so you can correct typing errors at leisure by using the back-space key.

"D" tells the Auto Dial 212A to dial the phone number that follows. For example, to dial 1(312) 123-4567, the command would be "ATD13121234567"

Spaces, parentheses, hyphens and other punctuation characters are ignored with the exception of comma. For example, "ATD1(312)-123-4567," "ATD1(312)-123-4567" and "ATD13121234567" are all equivalent.

Inserting a comma in the character stream causes a two second delay in the dialing process. Inserting two consecutive commas would cause a four second delay, etc. (On some telephone systems, you must dial "9" to get an outside line, then dial the number you wish to call. Frequently, there is a delay before you get an available line after dialing "9". To successfully dial a number under these circumstances, you would enter: "ATD9,13121234567".

After dialing, the Auto Dial 212A attempts to establish a data link for 30 seconds. If a data link is not established (for example if the line was busy or there was no answer) the Auto Dial 212A sends the message "NO CARRIER" to the terminal or computer. If a data link is established, the Auto Dial 212A sends the message "CONNECT" to the computer or terminal.

The Auto Dial 212A is capable of pulse dialing and touch tone dialing. When initially powered on, it is set for pulse dialing. To change to touch tone, enter "ATT". To return to pulse dialing, enter "ATP". The "T" and "P" commands can be made part of the dialing command. For example, to dial touch tone, you could enter: "ATDT 13121234567". The number stream can be broken up into touch tone segments and pulse dialed segments. For example: "ATDT9,,,P1312,T1234567" would touch tone dial 9, pause 6 seconds, pulse dial 1312, pause 2 seconds, touch tone dial 1234567. The modem remains in the last setting it receives, in this case, "T", until commanded to change.

Typing any key while the modem is dialing or waiting for a carrier will abort the call and return you to command mode.

AUTO ANSWER OPERATION

When initially powered on, the Auto Dial 212A is in Answer/Command mode, waiting for an incoming call or a command from the terminal or computer to place an outgoing call. When a call comes in, the modem says "RING", goes off hook to answer the call, and waits up to 17 seconds for a carrier. It then sends the message "CONNECT" or "NO CARRIER" to the terminal. Upon termination of the call, the Auto Dial 212A will hang up and await the next incoming call. Leave the modem powered off when you are using the same phone line for conventional incoming calls.

AUTO DIAL 212A COMMANDS

All commands must be initiated by the two character code "AT." The Auto Dial 212A operates at even, odd, mark, or space parity with one or two stop bits. The modem recognizes the appropriate configuration from the "AT" command it receives from the terminal and adjusts itself accordingly. Likewise, it selects the correct baud rate of 1200 baud or anywhere in the range from 110 to 300 baud.

A command can be a total of 60 characters in length. Spaces are not counted as part of the command. Multiple commands may be entered on the same line, for example: "ATVØMØ (cr)" would tell the modem to go to terse mode, and turn off the speaker (see below).

After the modem has executed the command or commands it will wait 250 milli-seconds and respond "OK."

LIST OF COMMANDS

- A** Answer mode. The modem will go into answer mode without having received a ring. This may also be accomplished by the RNG switch.
- A/** Every command is remembered until the next command is entered. To re-execute the last command entered without re-typing it, type "A/" (note, "A/" is typed in place of "AT(cr)"). This is especially useful for redialing a busy number.
- D** Dial a number and go into originate mode (see Auto Dial operation).
- P** Pulse Dial
- T** Touch Tone
- '** 2 second pause
- The "D" command must be the last command in a multiple command line.
- EØ=** Do not echo back command characters (default)
- 1=** Echo back command characters
- FØ=** Half duplex
- 1=** Full duplex (default)
- MØ** Speaker always off
- 1=** Speaker on at beginning of call until carrier established (default)
- 2=** Speaker on during entire call (sometimes useful for debugging)
- P** Pulse dial
- QØ=** Result messages sent (default)
- 1=** Result messages made "Quiet", useful when modem messages would interfere with data stream

- S Set register commands. These commands are of the form "Sx=n" where "x" is one of the S registers and "n" is a number between 0 and 255, e.g. "ATSO=7" will answer on the 7th ring.
- S0=n Will answer calls on the nth ring. The special case "S0=0" may be used to disable Auto Answer operation.
- S2=n This sets the escape code character (see +++ below). The default is "S2=43" (ASCII code for +).
- S7=n Length of time (in seconds) modem will wait for carrier when originating a call, (defaults to 30). Especially useful for international calls, where it may take over 60 seconds to reach the called party.
- T Touch tone dial
- V0= Terse; terse codes are only followed by a carriage return.
- 1= Verbose (default); verbose responses are preceded and followed by a CR/LF.

Response Codes—

Verbose	Terse
OK	0
CONNECT	1
RING	2
NO CARRIER	3
ERROR	4
CONNECT 1200	5

X0= Standard result code set (result codes 0 thru 4), (default)

1= Extended result code set (result codes 0 thru 5)

When "ATX1" is issued the modem will respond "CONNECT 1200" on high speed calls and "CONNECT" for low speed calls. (See High Speed/Low Speed Protocol)

Z Reset. This will reset the modem as if it had just been powered on, and will clear all registers to their default values.

+++ Escape code sequence. The Auto Dial 212A can be forced to disconnect a data call and return to command state by sending it the code "+++" preceded and followed by at least one second of no data. This is the only command which the modem accepts while online and connected to another modem. The escape guard time of one second protects against being cut off by a "+++" in the transmit data stream. In addition, the escape code may be changed from a "+" to another character by using the S2 command.

VOICE/DATA COMMUNICATION

Two parties may communicate by voice and then turn the same call over to their modems by following these steps:

- Without hanging up the phones, one party should type "ATD (cr)", to put their modem in originate mode, while the other types "ATA (cr)" to put their modem in answer mode.
- The phones may then be hung up and the modems should hold the line and establish a link.

Alternately, the party on the answer side may depress the RNG switch instead of typing "ATA". Sometimes several garbage characters will appear when one hangs up the phone. These can be avoided by hanging up the phone as soon as the modem goes off hook (in the one- to two-second handshaking period).

HIGH SPEED/LOW SPEED PROTOCOL

In ORIGINATE MODE, the Auto Dial 212A selects 300 baud or 1200 baud modem standards based on the baud rate of the terminal or computer giving it the dial command. The modem will respond "CONNECT", "CONNECT 1200" (if extended result codes are requested), or "NO CARRIER" at the baud rate of your terminal.

In AUTO ANSWER MODE, the modem must communicate to the computer whether a High Speed or Low Speed call is coming in. The modem does this by raising the voltage on pin 12 on the RS232 interface for a high speed call and lowering it for a low speed call, and also by saying "CONNECT" for a 300 baud call, and "CONNECT 1200" for a 1200 baud call (if extended result codes are in effect). The modem will give these responses to the computer at the old baud rate before changing to the new baud rate. If the modem is powered up and no commands are issued to it, it defaults to 1200 baud.

If your computer does not respond automatically to incoming calls at different baud rates, you may be able to program it to do so. Use the following example as a guide:

ACTION	MODEM MODEM RESPONSE RESPONSE BAUD RATE	MODEM
1. Power on.		
2. Low speed call comes in.	"RING" "CONNECT"	1200 1200
3. Data link is established. Data transmission takes place at 300 baud.		
4. End of data session. Call is ended. Loss of carrier.	"NO CARRIER"	300
5. High speed call comes in.	"RING" "CONNECT 1200"	300 300
6. Data link is established. Data transmission takes place at 1200 baud.		
7. End of data session. Call is ended. Loss of carrier.	"NO CARRIER"	1200

In the above example:

1. The modem is powered on. No command is initially given to the modem so, by default, it operates at 1200 baud.

2. A remote terminal or computer with a 300 baud modem calls up the Auto Dial 212A. The Auto Dial 212A senses the incoming ring signal and sends the messages "RING" and "CONNECT" to the computer it is connected to via the RS232 interface. These messages are sent at 1200 baud since the Auto Dial 212A has been operating at 1200 baud since it was powered on.

3. Since the Auto Dial 212A responded "CONNECT" rather than "CONNECT 1200", your computer must recognize that the incoming call is at 300 baud and adjust accordingly. After sending the message "CONNECT", the Auto Dial 212A automatically shifts to 300 baud operation to accept data from the incoming call.

4. The data session is ended and the modem drops carrier. It responds "NO CARRIER" to your computer via the RS232 interface. Since it was last operating at 300 baud, this response is sent at 300 baud.

5. A high speed call comes in. The modem responds "RING" "CONNECT 1200". Since the modem was last operating at 300 baud, this response is sent at 300 baud.

6. Since the Auto Dial 212A responded "CONNECT 1200" rather than "CONNECT", your computer must recognize that the incoming call is at 1200 baud and adjust accordingly. After sending the message "CONNECT 1200", the Auto Dial 212A automatically shifts to 1200 baud operation to accept data from the incoming call.

7. The data session is ended and the modem drops carrier. It responds "NO CARRIER" to your computer via the RS232 interface. Since it was last operating at 1200 baud, this response is sent at 1200 baud.

IF YOU ENCOUNTER TROUBLE

CONDITION

PROCEDURE

Modem will not answer the phone, or go Off Hook to dial.

Verify that the TR light on the front of the modem is on. If it is not, your system may be providing a negative voltage on pin 20. (See Data Terminal Ready override.)

Modem doesn't recognize upper case "AT (cr)" and respond "OK."

1) When you type "AT", the SD (Send Data) light should flicker. If not, verify that the terminal is in online mode, and check that it is sending on pin 2 (see Send/Receive Data). If terminal requires pin 8 high, put 8HI switch off.

2) SD light flickers but RD doesn't flicker in response. verify that terminal is set to 1200 or 300 baud. Verify that computer I/O board or terminal is set properly (see Bits Per Character).

3) SD light flickers and RD flickers in response but system doesn't receive "OK". Follow procedure given in step 1.

Modem causes a process on the system as if a call has already come in.

The system may read pin 8 for carrier detect. Turn the 8HI switch on and proceed.

Computer receives a carriage return before one is typed by the originating terminal.

When a call comes in, modem sends CR/LF "RING" CR/LF, and then CR/LF "CONNECT" CR/LF. These may be eliminated by electing Quiet mode, "Q1," or Terse mode, "V0."

Carrier LED does not light up, and data connection is not made.

1) Perform Analog Loopback, Self Test procedure as described in later section.

2) Track the call via the on-board speaker. The proper sequence for a low speed call is: Answer modem answers and puts out a high pitched clear tone. Originating modem should respond with a lower pitched clear tone.

For a high speed call, the sequence is: Answer modem puts out a high pitched clear tone. Originating modem responds with a raspy sounding lower pitched noise. Answer modem should switch to a raspy sounding higher pitched noise.

3) Verify the quality of your line. Communication is often impossible over MCI Sprint and other microwave carrier networks. Try several calls. Try calling from another line and/or calling to another modem if possible, before calling U.S. Robotics for technical support.

Connection is made but characters come through transformed into other characters.

This is usually an indication of a difference in parity or word length between the sending and receiving systems. Major timesharing networks such as TYMNET have different initial protocols which must be followed depending on the caller's terminal type and parity. We have found the most common setting to be one start bit, seven data bits, MARK parity, and one stop bit. Sometimes the parity and word length settings which worked for 300 baud will not work for 1200 baud and must be changed.

Connection is made, but modem is receiving wiggly . brackets “}” or “}i” while idling.

1200 baud modems function differently than 300 baud modems in that they are constantly sending and receiving scrambled phase changes even when the computer or terminal is sending nothing, i.e. all marks. If there is any kind of line problem,

it will cause a phase change to be misinterpreted and to appear as a character (often “}”) to the terminal. On most lines, these problems are infrequent and one may communicate for long periods of time without a problem. On a few lines the errors are excessive and make useful data transmission impossible. If such is the case, try the following before calling U.S. Robotics for technical support.

- 1) Try placing the call again. Even on local calls the telephone network will route the call differently each time.

- 2) Try using the modem from another line and calling other modems than the one you are having trouble with if possible. The problem may be with your line or with the line or modem at the other end.

- 3) Calls placed over microwave carriers such as MCI and Sprint will often have errors. Also, many large institutions have PBX's (Private Branch Exchanges) which use digital encoding techniques on their phones. These are often provided with RJ11C jacks but are incompatible with modems. Sometimes the PBX vendor can provide an analog converter which will enable modems to be used on the line. Another problem which sometimes occurs is that the signal within the PBX is exceptionally strong and undistorted. The modem contains an equalizer which

compensates for an average phone line. The BAL switch on the back may be turned ON to make such a PBX look more like an average line to the modem.

Double characters are displayed at terminal.

- 1) If "F0", half duplex, is in effect select "F1", full duplex.
- 2) If "F1" is already selected, turn local echo off on your terminal or select full duplex on your terminal.

DATA TERMINAL READY OVERRIDE— (Dip Switch Segment 4)

When Dip Switch Segment 4 is turned off, a high voltage must be provided on the Data Terminal Ready signal of the RS232C interface (pin 20) for the Auto Dial 212A to work. If this signal is not provided to the modem by your terminal or computer, the modem will not send or receive data. This capability is especially useful when using the Auto Dial 212A in auto answer mode with your computer. By controlling pin 20 on the RS232C interface, your computer can control whether or not the Auto Dial 212A will answer incoming calls. Even after a data link has been established, your computer can disconnect the call at any time by turning off pin 20. This provides an added security capability to your system.

With the Auto Dial 212A and your terminal or computer powered on, the TR (data terminal ready) light on the front of the unit will light up if your terminal or computer provides a high voltage on DTR. If the TR light does not come on, select DTR override (dip switch segment 4 on).

ANALOG LOOPBACK, SELF TEST

To test the Auto Dial 212A for proper functioning, engage the AL button on the front of the unit and power the unit off, then on. This connects the unit to the phone line, making it busy. After testing the unit as described below, disengage the AL button, power the modem off, then on and the modem will return to normal operation.

Under the test procedure, the receive channel frequencies are the same as the transmit channel frequencies, so that data sent by the terminal is modulated and demodulated by the modem and transmitted back to the terminal. To perform Self Test in originate mode, type "ATD" at any speed. The OH light should go on, and then the CD light should go on. Characters typed at the terminal will be transmitted through the Auto Dial 212A and displayed on the terminal if the modem is functioning properly. To perform Self Test in answer mode, type "ATA". The OH and CD lights should go on. Watch the HS light to see whether a 1200 baud or 300 baud test is in effect and set your terminal accordingly.

Local echo (half duplex) should **not** be selected on either the modem or the terminal during the Self-Test. The Data Terminal Ready signal must be provided to the Auto Dial 212A for the self-test to work. If indicator TR does not light, see the Data Terminal Ready Override section of this manual.

SEND/RECEIVE DATA

Pins 2 and 3 of the RS232C interface are used to send and receive data between the Auto Dial 212A and the computer or terminal. The factory setting provides for data to be sent out of the modem on pin 3 and received by the modem from the terminal or computer on pin 2. Some computers and terminals reverse these functions on pins 2 and 3. If necessary match the function of these pins by resetting a dip switch located inside the modem.

CAUTION: Changing the function of pins 2 and 3 is rarely required. Before making a change, compare the RS232C pin definitions of the Auto Dial 212A (given in this manual) with the definitions for your computer or terminal. Never select switch settings other than those in the table below. Damage to the equipment may result.

To reach the switches, remove the back cover of the Auto Dial 212A and slide the circuit board out of the case. The following table shows the appropriate switch settings.

Auto Dial 212A

<i>Pin 2 Receive</i> (from terminal)		<i>Pin 2 Send</i> (to terminal)	
<i>Pin 3 Send</i> (to terminal)		<i>Pin 3 Receive</i> (from terminal)	
(Factory Setting)			
Segment	Setting	Segment	Setting
1	ON	1	OFF
2	ON	2	OFF
3	OFF	3	ON
4	OFF	4	ON

On some units, the control for pins 2 and 3 may be a pair of three-post connectors with jumpering shunts, J3 and J4, rather than the four position dip switch described above. If this is the case, the jumpering shunt on each connector should connect the middle post of the connector to the post nearest the interior of the circuit board for the modem to receive on 2 and to transmit on 3 (factory set). To reverse 2 and 3, move the jumpering shunts on J3 and J4 so that the middle post of each connector is connected to the post nearest the outer edge of the circuit board.

BITS PER CHARACTER

A single character of data transmitted in serial format consists of seven DATA BITS (0's and 1's) that define the character. In addition, this information is preceded by a START BIT and trailed by a PARITY BIT and a STOP BIT for a total of 10 bits per character.

The term "baud rate" refers to "bits per second" transmitted by the communications equipment. A 1200 baud modem transmits 1,200 bits per second.

At 10 bits per character, this equals 120 characters per second or 120 CPS.

10 bits per character is industry standard. However, some equipment is designed to function with 8 data bits, resulting in 11 bits per character. You must select 11 bits per character via a jumper switch, J2, inside the unit. Push it down (closed) to select 11 bits. The factory setting is for 10 bits per character, by far the most common requirement.

On some units, J2 may be a three-post connector and jumpering shunt rather than a push/pull switch. If this is the case, the jumpering shunt should connect the middle post of the connector to the post nearest the outer edge of the circuit board for 10-bit transmission (factory set). For 11-bit transmission, move the jumpering shunt so that it connects the middle post to the post nearest to the interior of the circuit board.

TECHNICAL SUMMARY

Data Rate: 1200 baud asynchronous
0-300 baud asynchronous

Modulation:

Quadrature Phase Shift Keying (QPSK)—
1200 baud

Frequency Shift Keying (FSK)—300 baud

Compatibility: Bell 212A series—1200/300 baud

Operating Modes: Auto Dial
Auto Answer
Manual Answer
Manual Originate

Switch Selectable Options:

Front Panel Switches:

ON—Power

AL—Analog Loopback (self-test)

Back Panel Dip Switch:

1. Manual Ring

2. Pin 8 High

3. Line Balancing

4. Data Terminal Ready override

Internal Dip Switch:

RS232C pins 2 and 3 reversible

Transmit Level: -9dBm

Receive Sensitivity: -48dBm

Digital Interface: RS232C via 25-pin female connector on modem

Phone Line Interface: via RJ11C standard phone jack

Power Requirements: 115 VAC, 60Hz;
12 VAC adapter only.

Indicators:

OH - Off Hook
CD - Carrier Detect
ON - Power On
AL - Analog Loopback
TR - Terminal Ready
SD - Send Data
RD - Receive Data
AN - Answer Mode
HS - High Speed

Construction:

Computer-designed digital filters
—crystal controlled.

Digital microprocessor-based
design — crystal controlled.

Configuration: Stand-alone. Power supply
and phone line interface cord
included.

Color: Brushed, anodized aluminum exterior.

Size: 9½"L × 5½"W × 1⅝"H

Weight: 2 lbs.

RS-232C INTERFACE PIN DEFINITIONS

- 2 Transmit Data, terminal to modem
(with respect to telephone line)
- 3 Receive Data, modem to terminal
(with respect to telephone line)
- 5 Clear to Send
- 6 Data Set Ready
- 7 Signal Ground
- 8 Carrier Detect
- 12 Speed Indicate
- 20 Data Terminal Ready
- 22 Ring Indicator

WARRANTY

U.S. Robotics, Inc., warrants to the original consumer purchaser that this product is free from any defects in materials or workmanship for a period of two years from the date of purchase. If such defect is discovered within the warranty period, U.S. Robotics, Inc.'s sole obligation will be to repair or replace, at its election, the product free of charge on receipt of the unit (charges prepaid if mailed or shipped) with proof of date of purchase. This warranty shall not apply if the product is modified, tampered with, misused or subjected to abnormal working conditions.

Consequential or incidental damages resulting from a breach of any applicable express or implied warranties are hereby excluded. Some states do not allow limitations on how long an implied warranty lasts or do not allow the exclusion of limitations of incidental or consequential damages, so the above limitations or exclusions may not apply to you.

This warranty gives you specific legal rights and you may also have other rights which vary from state to state.

IMPORTANT: If you ship your unit, package it securely and ship it charges prepaid and insured, by parcel post or United Parcel Service.